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(54) **PUMP DRIVE LAUNCH DEVICE ACTUATOR**

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(51) **Int. Cl.**

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| ***F16D 25/08*** | (2006.01) |
| ***F16D 43/284*** | (2006.01) |

(52) **U.S. Cl.**

CPC ..... ***F16D 25/06*** (2013.01); ***F16D 25/08*** (2013.01); ***F16D 25/086*** (2013.01); ***F16D 25/087*** (2013.01); ***F16D 43/284*** (2013.01); *F16D 2300/24* (2013.01)

(58) **Field of Classification Search**

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USPC ..... 192/85.5, 85.48, 85.49, 85.51, 85.57; 417/223, 316, 364; 464/168

See application file for complete search history.

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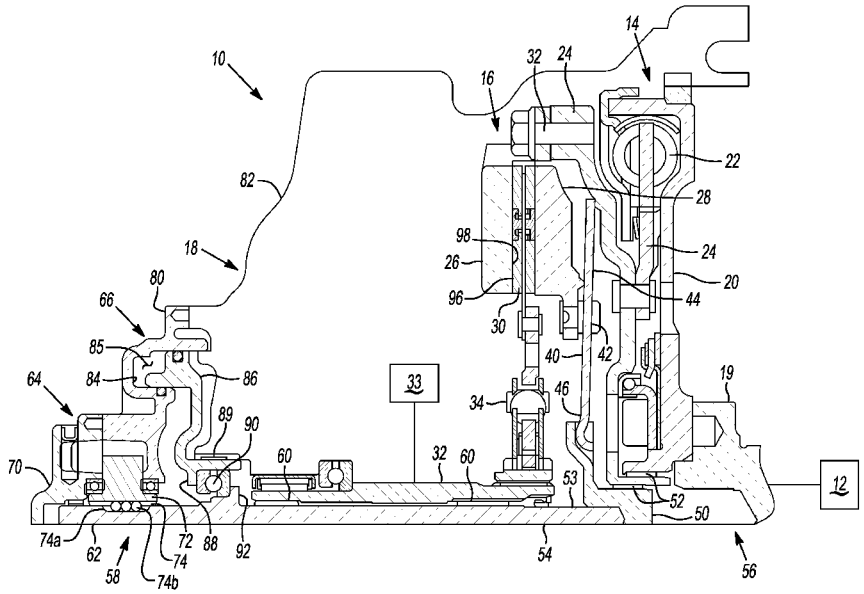
(57) **ABSTRACT**

A powertrain includes an engine, a transmission, a pump for providing pressurized hydraulic fluid and a launch clutch connected between the engine and the transmission for coupling the engine to the transmission when the launch clutch is in an engaged condition and for decoupling the engine from the transmission when the launch clutch is in a disengaged condition. A device is rotationally coupled to the engine and to the pump. The device is translatable along an axis between a first position and a second position. The device moves the launch clutch to the engaged condition when in the first position and does not move the launch clutch to the engaged condition when in the second position. A piston in communication with the pressurized hydraulic fluid provided by the pump is configured to translate the device along the axis between at least one of the first and second positions.

**19 Claims, 1 Drawing Sheet**



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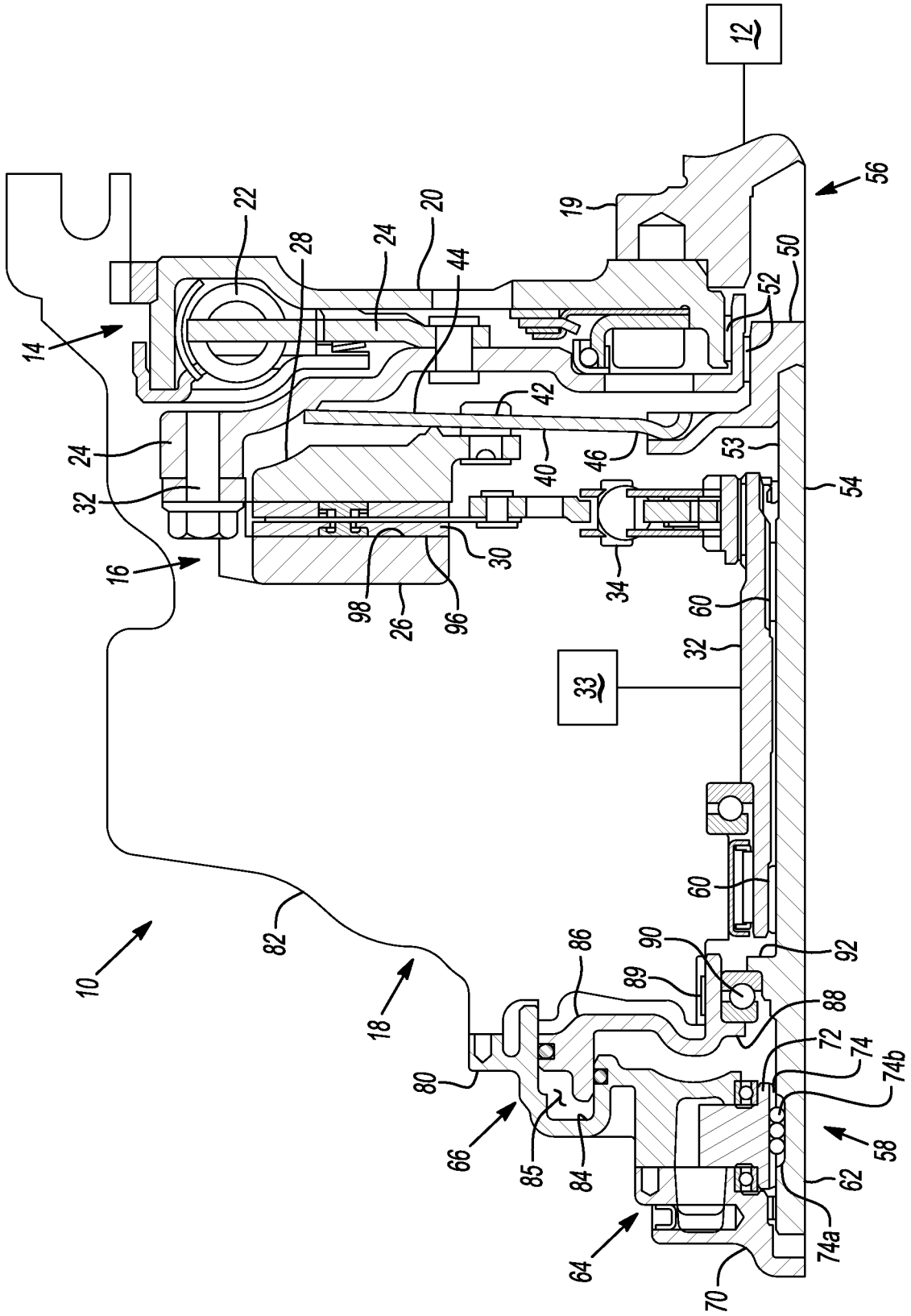
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# PUMP DRIVE LAUNCH DEVICE ACTUATOR

## CROSS-REFERENCE

This application claims the benefit of U.S. Provisional Application No. 61/542,587 filed on Oct. 3, 2011. The disclosure of the above application is incorporated herein by reference.

## FIELD

The invention relates generally to a pump drive clutch actuator, and more particularly to a pump drive clutch actuator multiplexed to a pump assembly and a launch device in a powertrain.

## BACKGROUND

The statements in this section merely provide background information related to the present disclosure and may or may not constitute prior art.

A typical multi-speed automatic transmission uses a combination of torque transmitting devices, such as clutches or brakes, to achieve a plurality of forward and reverse gear or speed ratios as well as a Neutral and a Park. Selection of speed ratios is typically accomplished by a microprocessor transmission control module that employs various vehicle parameters, for example vehicle speed, and various driver input signals, for example accelerator pedal position, to select the appropriate speed ratios. The transmission then engages a combination of the torque transmitting devices to provide the desired speed ratios.

The launch of the automatic transmission, i.e., the transfer of torque from an engine or power source to the transmission at engine start-up, is typically accomplished by a traditional torque converter that transfers torque via fluid coupling or by a wet clutch. Dry friction clutches, which exist within a transmission for normal ratio changing purposes, may also serve as launch clutches under certain conditions. However, the need to efficiently package these dry friction clutches, as well as components of the transmission including input shafts and pump assemblies, remains constant. Therefore, there is a need in the art for transmission and powertrain architecture that maximizes performance and fuel efficiency while minimizing packaging space and weight.

## SUMMARY

A device for driving a pump and actuating a launch clutch in a powertrain for a motor vehicle is provided. The powertrain includes an engine, a transmission, and a launch clutch connected between the engine and the transmission for coupling the engine to the transmission when the launch clutch is in an engaged condition and for decoupling the engine from the transmission when the launch clutch is in a disengaged condition. The powertrain also includes a pump for providing pressurized hydraulic fluid. The device is rotationally coupled to the engine and to the pump. The device is translatable along an axis between a first position and a second position. The device moves the launch clutch to the engaged condition when in the first position and does not move the launch clutch to the engaged condition when in the second position. A piston in communication with the pressurized hydraulic fluid provided by the pump is configured to translate the device along the axis between at least one of the first and second positions.



In one aspect of the present invention, the device includes a shaft connected to a radial member and the shaft is rotationally coupled to the engine and to the pump and the radial member is connected to the launch clutch.

In another aspect of the present invention, the radial member is a spring plate that biases the launch clutch to the engaged condition.

In yet another aspect of the present invention, the spring plate is generally centrally pivoted by an annular pivot located on the launch clutch.

In yet another aspect of the present invention, the spring plate is secured at an inner diameter to a spring hub and the spring hub is connected to a first distal end of the shaft.

In yet another aspect of the present invention, a damper is connected between the launch clutch and the engine and the damper is supported for rotation on the spring hub by a plurality of bearings.

In yet another aspect of the present invention, the device includes an axially extended shaft having a first distal end and a second distal end, and the first distal end is connected to the launch clutch and the second distal end is connected to the pump.

In yet another aspect of the present invention, the shaft extends from a front of the transmission to a rear of the transmission.

In yet another aspect of the present invention, the transmission includes a transmission input shaft coupled to the launch device, and the transmission input shaft is supported for relative rotation on the shaft by a plurality of bearings.

In yet another aspect of the present invention, the pump includes a pump rotor connected to the second distal end of the shaft.

In yet another aspect of the present invention, a biasing member and hub are connected to the first distal end of the shaft.

In yet another aspect of the present invention, the pump rotor is coupled to the shaft by a ball splined connection that includes splines that rotationally couples the pump rotor to the shaft and bearings that allow the shaft to translate along the axis without rotationally decoupling from the pump rotor.

In yet another aspect of the present invention the piston is disposed between the pump and a rear wall of the transmission.

In yet another aspect of the present invention the piston includes a radial flange connected to an axial flange, and the axial flange contacts an apply-through bearing disposed between the piston and the device.

In yet another aspect of the present invention the device includes a shaft having a radially extended flange, and the apply-through bearing contacts the radially extended flange.

Further examples, aspects and advantages of the present invention will become apparent by reference to the following description and appended drawings wherein like reference numbers refer to the same component, element or feature.

## DRAWING

The drawing described herein is for illustration purposes only and is not intended to limit the scope of the present disclosure in any way.

The drawing is a cross-sectional view of a powertrain according to the principles of the present invention.

## DETAILED DESCRIPTION

The following description is merely exemplary in nature and is not intended to limit the present disclosure, application, or uses.

With reference to FIG. **1**, a powertrain for a motor vehicle is generally indicated by reference number **10**. The powertrain includes a prime mover **12** drivingly coupled to a damper **14** which in turn is drivingly coupled to a launch device **16** and a transmission **18**. The prime mover **12** provides an output torque through the damper **14** and the launch device **16** to the transmission **18**. The prime mover **12** is, for example, an internal combustion gas, Diesel or flex-fuel engine or an electric motor. The prime mover **12** includes a crankshaft **19** which is secured to a circular input plate **20** of the damper **14**. The circular input plate **20** is coupled through damper members **22** to a circular output plate **24** of the damper **14**.

The launch device **16** is a dry clutch launch device that receives drive torque from the circular output plate **24** of the damper **14**. The launch device **16** includes a first friction plate or backing plate **26**, a second friction plate or pressure plate **28**, and a hub plate or clutch disk **30** disposed between the backing plate **26** and the pressure plate **28**. The backing plate **26** is rigidly coupled to the output plate **24** of the damper **14** via fixed connections **32**. The clutch disk **30** is connected for rotation with a transmission input member **32**. The transmission input member **32** is coupled to a gear and clutch arrangement schematically indicated by reference number **33**. It should be appreciated that any number of clutches, brakes, gear sets, and shafts or members may be arranged in the gear and clutch arrangement **33** without departing from the scope of the present invention. An optional damping element **34** may be disposed between the clutch disk **30** and the input member **32** to absorb engine vibrations. The pressure plate **28** is secured to a diaphragm spring or spring plate **40** via a retainer **42**. The spring plate **40** is generally centrally pivoted by annular pivot **44** located on the pressure plate **28**. The spring plate **40** normally biases the pressure plate **28** in contact with the clutch disk **30** to engage the clutch disk **30** with the backing plate **26**.

The spring plate **40** is secured at an inner diameter **46** to a spring hub **50**. Both the input plate **20** and the output plate **24** of the damper **14** are supported for rotation on the spring hub **50** via bearings **52**. The spring hub **50** is rotationally fixed to a distal end **53** of a pump drive/launch device apply actuator or shaft **54**. The shaft **54** extends from a front **56** of the transmission **18** to a rear **58** of the transmission **18**. The transmission input shaft **32** is supported for relative rotation on the shaft **54** via bearings **60**, thereby making the transmission input shaft **32** a sleeve shaft (i.e. concentric with the shaft **54**).

The shaft **54** is coupled at a second distal end **62** to a pump assembly **64** and a launch clutch actuation device **66**. The pump assembly **64** generally includes a pump body **70** having a pump rotor **72**. The pump rotor **72** is rotationally splined to the shaft **54** via a ball splined connection **74**. The ball splined connection **74** includes splines **74**A for rotationally coupling the pump rotor **72** to the shaft **54** as well as ball bearings **74**B for permitting the shaft **54** to move axially with respect to the pump assembly **64**.

The launch clutch actuation device **66** includes a housing **80** sealingly engaged to the pump body **70** and to a transmission case **82** of the transmission **18**. The housing **80** includes a cylinder **84** concentrically disposed about the shaft **54** that defines a cylinder chamber **85**. A piston **86** is slidably disposed within the cylinder **84**. The piston **86** is axially translatable via control of hydraulic fluid within the cylinder chamber **85**. For example, the cylinder chamber **85** may be filled with transmission fluid under control by a transmission control unit (not shown), as will be well understood by those skilled in the art, to extend or retract the piston **86**. The piston **86** includes an inner edge or flange **88** and an axial flange **89** that contacts an apply-through bearing **90**. The apply-through bearing **90** also contacts a radially extending flange **92** located on the shaft **54**, thereby axially and radially sandwiching the apply-through bearing **90** between the piston **86** and the shaft **54**.

As described above, the backing plate **26** and the damper **14** are all connected for rotation with the crankshaft **19** and therefore rotate at the same speed as the engine **12**. Output torque from the engine **12** is transmitted to the transmission **18** and the pump assembly **64** by engaging the launch device **16**, thereby rotationally coupling the backing plate **26** to the clutch disk **30** and the pressure plate **28**. For example, when the launch clutch actuator assembly **66** is controlled to extend the piston **86** toward the clutch disk **30**, the piston **86** moves the apply-through bearing **90** towards the shaft **54**. The shaft **54** is translated axially towards the launch device **16** without being rotationally decoupled from the pump rotor **72**. Axial movement of the shaft **54** compresses the spring plate **40** to release the pressure plate **28** from the clutch disk **30** and thereby disengage the clutch disk **30** from the backing plate **26**. The spring plate **40** moves the pressure plate **28** axially via the retainer **42**. Conversely, when the launch clutch actuator assembly **66** is controlled to retract the piston **86** within the cylinder **84**, the apply-through bearing **90** moves axially away from the shaft **54**. The spring plate **40** is able to pivot and axially translate the shaft **54** towards the pump assembly **64**. In addition the spring plate **40** pivots at the annular pivot **44** to move the pressure plate **28** into contact with the clutch disk **30**. A friction surface **96** of the clutch disk **30** then comes into contact with an opposing adjacent friction surface **98** of the backing plate **26**, thereby rotationally coupling the output of the engine **12** to the transmission input shaft **32** and the shaft **54**. Notably, the frictional contact between the adjacent friction surfaces **96**, **98** is not lubricated; thus, the heat of frictional contact is dissipated by the pressure plate **28** and the damper **14**. Lubrication fluid is not required for cooling the friction surfaces **96**, **98**. Thus, associated spin losses and pumping losses are not encountered.

The shaft **54** allows the pump assembly **64** to be packaged on the rear **58** of the transmission **18** where it has easy access to the oil sump (not shown) and transmission controls system (not shown), resulting in a small drive radius and higher pump efficiency. In addition, the multiplexing of the shaft **54** to the pump assembly **64** and the launch clutch actuator assembly **66** results in a reasonably sized transmission input shaft **32** that does not significantly enlarge the gearsets of the transmission **18**.

The description of the invention is merely exemplary in nature and variations that do not depart from the gist of the invention are intended to be within the scope of the invention. Such variations are not to be regarded as a departure from the spirit and scope of the invention.

The following is claimed:

**1**. A powertrain comprising:

an engine;

a transmission having a transmission input shaft;

a launch clutch connected between the engine and the transmission input shaft for coupling the engine to the transmission when the launch clutch is in an engaged condition and for decoupling the engine from the transmission when the launch clutch is in a disengaged condition;

a pump for providing pressurized hydraulic fluid;

a device rotationally coupled to the launch clutch and to the pump, wherein the device is translatable along an axis between a first position and a second position, wherein the device moves the launch clutch to the engaged con-

dition when in the first position and does not move the launch clutch to the engaged condition when in the second position, and wherein the transmission input shaft is supported for rotation on the device;

a piston in communication with the pressurized hydraulic fluid provided by the pump and configured to translate the device along the axis between at least one of the first and second positions.

**2**. The powertrain of claim **1** wherein the device includes a shaft connected to a radial member, wherein the shaft is rotationally coupled to the pump and the radial member is connected to the launch clutch.

**3**. The powertrain of claim **2** wherein the radial member is a spring plate that biases the launch clutch to the engaged condition.

**4**. The powertrain of claim **3** wherein the spring plate is generally centrally pivoted by an annular pivot located on the launch clutch.

**5**. The powertrain of claim **4** wherein the spring plate is secured at an inner diameter to a spring hub and wherein the spring hub is connected to a first distal end of the shaft.

**6**. The powertrain of claim **5** further comprising a damper connected between the launch clutch and the engine, and wherein the damper is supported for rotation on the spring hub by a plurality of bearings.

**7**. The powertrain of claim **1** wherein the device includes a shaft that is axially extended and has a first distal end and a second distal end, and wherein the first distal end is connected to the launch clutch and the second distal end is connected to the pump.

**8**. The powertrain of claim **7** wherein the shaft extends from a front of the transmission to a rear of the transmission.

**9**. The powertrain of claim **7** wherein the transmission input shaft is supported for relative rotation on the shaft by a plurality of bearings.

**10**. The powertrain of claim **7** wherein the pump includes a pump rotor connected to the second distal end of the shaft.

**11**. The powertrain of claim **10** further comprising a biasing member and hub connected to the first distal end of the shaft.

**12**. The powertrain of claim **11** wherein the pump rotor is coupled to the shaft by a ball splined connection that includes splines that rotationally couples the pump rotor to the shaft and bearings that allow the shaft to translate along the axis without rotationally decoupling from the pump rotor.

**13**. The powertrain of claim **1** wherein the piston is disposed between the pump and a rear wall of the transmission.

**14**. The powertrain of claim **13** wherein the piston includes a radial flange connected to an axial flange, and wherein the axial flange contacts an apply-through bearing disposed between the piston and the device.

**15**. The powertrain of claim **14** wherein the device includes a shaft having a radially extended flange, and wherein the apply-through bearing contacts the radially extended flange.

**16**. A powertrain comprising:

an engine having an engine output shaft:

a transmission having a transmission input shaft;

a launch clutch connected between the engine output shaft and the transmission input shaft for coupling the engine to the transmission when the launch clutch is in an engaged condition and for decoupling the engine from the transmission when the launch clutch is in a disengaged condition;

a pump having a pump rotor;

a spring plate connected to the launch clutch that biases the launch clutch to the engaged condition;

a shaft rotationally coupled to the pump rotor and to the spring plate, wherein the shaft translates against the bias of the spring plate to move the launch clutch to the disengaged condition;

a spring hub connected to the shaft and to the spring plate;

a damper connected between the launch clutch and the engine, and wherein the damper is supported for rotation on the spring hub by a plurality of bearings; and

an actuator configured to translate the shaft.

**17**. The powertrain of claim **16** wherein the spring plate is secured at an inner diameter to the spring hub and wherein the spring hub is connected to a first distal end of the shaft.

**18**. The powertrain of claim **17** wherein the shaft is connected to the pump rotor at a second distal end of the shaft.

**19**. The powertrain of claim **18** wherein the pump rotor is coupled to the shaft by a ball splined connection that includes splines that rotationally couples the pump rotor to the shaft and bearings that allow the shaft to translate along the axis without rotationally decoupling from the pump rotor.

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